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**ADST  
System/Segment Design Document  
for the  
Protocol Translator  
of  
Advanced Distributed Simulation Technology/  
Crew Station Research and Development Facility**

Loral Western Development Labs  
Electronic Defense Systems Software Department  
Software Engineering Laboratory  
3200 Zanker Road  
P.O. Box 49041  
San Jose, CA 95161-9041

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## **1 Scope**

### **1.1 Identification**

The approved identification number for ADST/CSRDF Protocol Translator(PT) System Design Document is ADST/WDL/TR--93--003071. The Protocol Translator's System Design is derived from "CSRDF/BDS-D Interface Step 2 Proposal", 31-Jan-92.

### **1.2 System Overview**

The Protocol Translator supports interoperability between the Simulation Networking (SIMNET) and the Distributed Interactive Simulation (DIS) network by translating to the protocol used on the receiving network.

### **1.3 Document Overview**

This document discusses the Protocol Translator system design in the following areas: Operational concepts, system architecture, processing resources, and hardware and software requirements.

## 2 Referenced Documents

### Non-Government documents

#### SPECIFICATIONS:

##### Other Government Agency

- [1.1] CSRDF/BDS-D Interface Step Two Proposal, 31-Jan-92 (Last updated 21-Feb-92 14:52)
- [1.2] Interface Control Document (ICD) for the BDS-D Network Interface, 14 February, 1992 (Last updated: 21-Feb-92 17:58)
- [1.3] CSRDF/BDS-D Interface Step Two Requirement, 14-Feb-92 (Last updated 21-Feb-92 14:30)

#### STANDARDS:

##### Military

- [2.1] Protocol Data Units for Entity Information and Entity Interaction in a Distributed Interactive Simulation, DIS standard 1.0 with Extension, May 8, 1992.
- [2.2] BBN Report No. 7627, The SIMNET Network and Protocols, version 6.6.1, June 1991.

#### DRAWINGS:

- [3.1] none

#### OTHER PUBLICATIONS:

- [4.1] none

### Non-Government documents

#### SPECIFICATIONS:

- [5.1] none

#### OTHER PUBLICATIONS:

##### Manual

- [6.1] none

### **3 Operational Concepts**

#### **3.1 Mission**

To provide interoperability between two networks using different protocols.

##### **3.1.1 User Needs**

The Protocol Translator is designed to make DIS-compliant simulators interoperable with SIMNET-compliant simulators.

##### **3.1.2 Primary Mission(s)**

The primary mission of the Protocol Translator is to provide interoperability between the Airnet Facility at Ft. Rucker, Alabama and the Crew Station Research & Development Facilities (CSRDF) in Mountain View, California.

##### **3.1.3 Secondary Mission(s)**

The secondary mission of the Protocol Translator is to translate between SIMNET version 6.6.1 and DIS 1.0 protocols.

#### **3.2 Operational Environment**

The Protocol Translator is intended to execute on a Sun Microsystems Sparc10 workstation with two Ethernet Interfaces, one for each network (SIMNET, DIS).

#### **3.3 Support Environment**

Operating System	- Sun Sparc2 SunOS Release 4.1.1 must support UDP/IP.
	- Sun Sparc10 SunOS Release 4.1.1 must support User Datagram Protocol
Environment	- UNIX
Language	- C
Compiler	- gcc version 1.40
	The gcc's preprocessor may not work for "ioctl.h" and "ttychars.h". Use the standard C preprocessor.
Debugger	- dbxtool (SunView Interface for the dbx source-level debugger.

### 3.3.1 Support Concept

A data logger and an Ethernet Analyzer comprise the necessary test equipment to support the Protocol Translator. The Protocol Translator will be maintained by the Loral Aerospace Services - Aviation Test Bed in Fort Rucker, Alabama. The Software Problem/Change Report (SP/CR) support will be valid for the duration of the contract. Software Problem/Change Report requests will be administered by Configuration Management at Loral Western Development Labs in San Jose, California.

### 3.3.2 Support Facilities

The software maintenance is supported on a Sparc10 or Sparc2 workstation at Loral Software development facility.

### 3.3.3 Supply

The Sun Sparc (Sparc10 or Sparc2) workstation generally only comes with one Ethernet interface. A new add-on Ethernet interface card is required. At least one spare Ethernet interface card should be kept available at all times in the unlikely event a swap-out is required. To accomplish this requirement, two spare Ethernet interface cards are needed. One is used as the replacement for the bad Ethernet card while the other remains as a backup in case the new replacement card goes bad before the original card returns from repairs.

### 3.3.4 Government Agencies

The development team includes the followings:

1. STRICOM
2. Loral
3. Naval Command Control & Ocean Surveillance Center (NCCOSC)  
Research, Development, Test Evaluation Division
4. Navy Research and Development (NRaD)
5. ETA
6. U.S. Army Aviation Systems Command (AVSCOM)
7. CAE - the on-site contractor at CSRDF.

The support agencies are: Loral WDL and CSRDF

The user agencies are: CSRDF and AVTB at Ft. Rucker

### 3.4 System Architecture

The Protocol Translator (PT) CSCI was developed to support message translation between SIMNET version 6.6.1 protocol at Ft. Rucker and DIS version 1.0 protocol at CSRDF for the Rotorcraft Pilots Associate (RPA) system. A Sun Sparc10 workstation, a UNIX-based Operating System, is used as the platform for the Protocol Translator application. The Sparc10 workstation requires two Ethernet interfaces. The SIMNET network interfaces to the Protocol Translator with an IEEE 802.3 Ethernet and the DIS network interfaces to the Protocol Translator with User Datagram Protocol/Internet Protocol (UDP/IP). A Long-Haul Network is used for transporting the DIS PDUs between the CSRDF and Ft. Rucker sites and a Long Haul Network is used to connect AirNet and Rotary Wing Aircraft (RWA) with the SIMNET Ethernet network and to route PDUs.

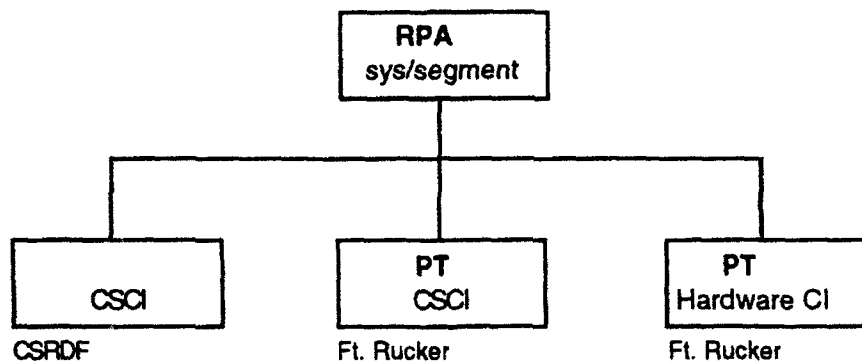


Figure 3.4.1. Protocol Translator System Architecture

### 3.5 Operational Scenarios

The Protocol Translator has two states: the blocking read and the blocking send. The Protocol Translator waits for incoming PDUs from either the SIMNET or DIS networks, then PDU translation is performed based on the PDUs' type and the translated PDUs are sent to the applicable network.

#### 3.5.1 Dead Reckoning

The Protocol Translator accounts for the fact that DIS is able to support a higher-order dead reckoning model than SIMNET. In this case, the dead reckoning software within the Protocol Translator ensures that SIMNET is still able to receive timely Vehicle Appearance updates. This process is handled by the following procedure.

1. An Entity State PDU is received from the DIS network.
2. A determination is made as to which dead reckoning algorithm is being used by the DIS Entity. If the algorithm is compatible with SIMNET, then no special processing needs to take place within the Protocol Translator. If the algorithm is a higher-order algorithm, the Protocol Translator dead reckoning software ensures that SIMNET will receive Vehicle Appearance PDU updates at the required rate.
3. A comparison is made between the position/orientation predicted by the standard SIMNET dead reckoning algorithm, and that predicted by the higher-order DIS algorithm. The time at which the positions/orientations deviate by a certain amount (as initialized in the /xlat/dead\_reckon/init\_dead\_reckoning.c file) is calculated. A timer is set to expire at this future time.
4. Upon timer expiration, the Vehicle Appearance PDU information for the entity is updated and a new Vehicle Appearance PDU is sent out to SIMNET. The timer is then set to expire at the calculated time interval again, and the process is repeated. Hence, for each Entity State PDU received, a number of Vehicle Appearance PDUs could be sent out to SIMNET.

If the DIS entity sends out a new Entity State PDU, the above procedure starts over again. However, if the DIS entity is known to have left the exercise, its dead reckoning calculations within the Protocol Translator are shut off.

Note that the whole above procedure is necessary because when using the higher-order dead reckoning model, Entity State PDU updates for a particular vehicle will be less frequent than they would be when using a lower-order dead reckoning algorithm, and hence, the "blanks", as seen from the SIMNET side need to be filled in. This filling-in is handled by the PT.

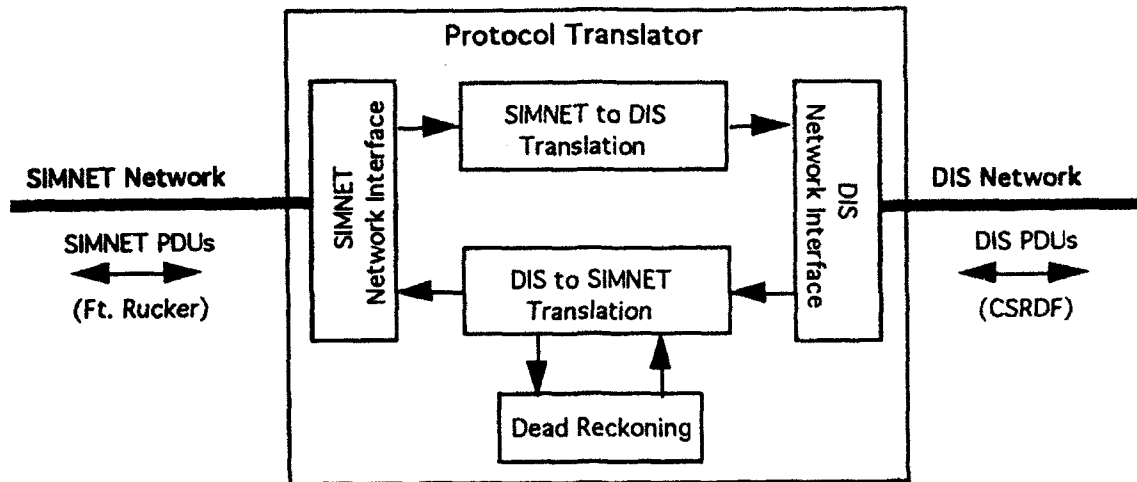


Figure 3.5. Protocol Translator Flow Diagram

## **4 System Design**

This section discusses the hardware and software configuration items, the manual operations, and internal interfaces of the Protocol Translator.

### **4.1 HWCI Identification**

#### **4.1.1 Sun Sparc**

Either a Sun Sparc10 or a Sparc2 workstation may be used to develop/maintain the Protocol Translator application. The Sparc must be configured with two Ethernet interfaces for DIS and SIMNET networks, and with an Internet address scheme for broadcasting and receiving DIS PDUs. There is no other hardware requirement for the Protocol Translator.

### **4.2 CSCI Identification**

#### **4.2.1 Protocol Translator - XLAT**

The Protocol Translator (XLAT) CSCI will translate DIS PDUs received from the DIS network into SIMNET PDUs and output them to the SIMNET network (and vice-versa for the incoming SIMNET PDUs). The software requirements for the Protocol Translator are as follows:

1. The CSRDF DIS version 1.0 protocol shall be transformed into SIMNET version 6.6.1 protocol.
2. The DIS 1.0 shall be introduced into SIMNET with little interference to existing operations.
3. The protocol transformation shall accommodate Ethernet LANs. (IEEE 802.3 Ethernet is the network used by SIMNET).

### **4.3 Manual operations Identification**

#### **4.3.1 Ethernet Interfaces to XLAT**

Protocol Translator interfaces with SIMNET PDUs from the SIMNET Ethernet network and interfaces with DIS PDUs that were transported by UDP/IP from the DIS network.

#### **4.4 Internal Interfaces**

##### **4.4.1 Ethernet - Long Haul Network /RWA Interface - XLAT**

The DIS Ethernet interface on the Sun Sparc10 workstation at Ft. Rucker shall interface with the Long-Haul Network.

The SIMNET Ethernet interface on the Sun Sparc10 workstation at Ft. Rucker shall interface with the local SIMNET network.

##### **4.4.2 Ethernet - Protocol Translator Interface - XLAT**

The Protocol Translator interfaces with the two Ethernet interfaces on Sun Sparc10 workstation. The Protocol Translator starts the translation process when DIS or SIM PDUs arrive at the Ethernet interfaces. The PDUs are then translated and sent to the applicable Ethernet interface.

##### **4.4.3 CSCI-to-CSCI Interface Name - XLAT**

There is no other CSCI within XLAT.

## 5 Processing Resources

### 5.1 (Processing resource name and project-unique identifier)

The Protocol Translator resides in a Sun Sparc10 workstation. It is implemented in the C programming language. To invoke the Protocol Translator, type "xlat". The Protocol Translator will translate incoming PDUs based on their message type and output the translated PDUs to designated networks.

- a. Memory size. 1860 Kbytes (Maximum real memory used during execution of the process).
- b. Word size. 32 bit word
- c. Processing speed. 100 percent usage. The speed is based on the number of PDUs being translated. Lower speed for slower processor and higher speed for higher processor.
- d. Character set standard. ASCII
- e. Instruction set architecture. standard 68020 on a Sparc10 or Sparc2 workstation
- f. Interrupt capabilities. Ctl-C, signal, timer, I/O blocking
- g. Direct Memory Access (DMA). N/A.
- h. Channel requirements. N/A
- i. Auxiliary storage. N/A
- j. Growth capabilities. N/A
- k. Diagnostic capabilities. User Interface , Debug Statements, Error-logging.
- l. Additional computer hardware capabilities. N/A
- m. Processing resource allocation. Share memory for Association transaction service. Shared memories for DIS and SIM for interfacing with the Protocol Translator User Interface.

May 7, 1993

**6     Quality Factor Compliance**

N/A

## 7 Requirements Traceability

Refer to the [1.3] for Requirement Description.

Requirement ID	S/SDD Paragraph
1.4-1	4.2.1-1
1.4-2	4.2.1-2
1.4-4	4.3.1, 4.4.1, 4.4.2
1.4-5	4.2.1-3

## 8 Notes

### Acronyms:

ADST	Advanced Distributed Simulation Technology
AVSCOM	U.S. Army Aviation Systems Command
AVTB	Aviation Test Bed
BDS-D	Battlefield Distributed Simulation - Development
CSRDF	Crew Station Research & Development Facilities
DIS	Distributed Interactive Simulation
NCCOSC	Naval Command Control & Ocean Surveillance Center
NRad	Navy Research and Development
PDU	Protocol Data Units
PT	Protocol Translator
RPA	Rotorcraft Pilots Associate
RWA	Rotary Wing Aircraft
SP/CR	Software Problem/Change Report
STRICOM	Simulation Training and Instrumentation Command
SIMNET	Simulation Networking
UDP/IP	User Datagram Protocol/Internet Protocol